

## A RE-SURVEY OF PAPAIPEMA SM. (LEPIDOPTERA)

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The intricacies of insect life are abysmal and any individual studies are bound to be incomplete and fragmentary. This is so axiomatic as to need no argument and may excuse the limited viewpoint of any single observer. However, as time goes on data and observable facts accumulate, given problems here and there gain enlightenment through various channels.

Retrospective deductions on the part of the writer based on "the sum of evidence" as this slowly evolves apparently offers some ground work for the serial arrangement of *Papaipema* species.

Conceived as an ontogenetic tree with its phylogenetic roots outcropping from supposedly more ancient genera, it is interesting to invade this vale of surmise.

To what extent these relationships can be shown in a list arrangement is unsatisfactory but should be undertaken. As building bricks there are the characters of the adults including of course the genitalia of both sexes, the gleanings from larval evidence backed by attending factors. Thus it becomes requisite to discourse somewhat at length taxonomically.

Also the final disposition of holotypes should be chronicled.

First, as to the generic basis whereupon Prof. J. B. Smith established *Papaipema* in 1899.<sup>1</sup>

He named no genotype and the gist of his characterizations featured moths with primaries rather broad and outwardly acute at apex; the thoracic tuftings decidedly upright and anteriorly usually broadened, in form like an "adze" behind the collar; the antennæ are simple; the frons smooth; the male genitalia mainly show a unique pattern "having the harpes more or less forked with triangular patch of spinulated surface at the tip. The clasper in almost all cases a long, stout, curved hook, but is unique in having the outer curve strongly toothed."

<sup>1</sup> Revision of *Hydroecia*, Trans. Am. Ent. Soc., Vol. XXVI.

As now considered there are nearly fifty species in the genus with thirty-seven at least following this genitalic pattern closely. Smith's simple drawings of a portion of the male genitalia are misleading however since it is necessary to chronicle the following specific errors.

*Harrisii* and *pterisii* were considered by him as one species; *duovata*, *arctivorens* and *merricata* at least were confused under "*rutila*"; *circumlucens*, *ochroptena* and form *humuli* were treated as *circumlucens*; he considered *cerussata* and *frigida* form *thalictri* under *cerussata* label; treated *purpurifascia* and *lysismachiae* as one; misidentified *sciata* for "*limpida*"; *nepheleptena* for *appassionata*, while his reference to *necopina* had largely to do with *maritima*.

Criticism should not be levied unduly at these presumed mistakes since some of Guenee's types, notably *rutila* and *limpida*, British Museum uniques, have not been satisfactorily associated, and two of our names as used hereinafter will probably fall through this lack of perception.

In 1910 Sir George Hampson,<sup>2</sup> following his custom of citing genotypes, selected *cerina* as genotype of *Papaipema*, on First Species Rule because it headed Smith's enumeration of the genus. That was an unfortunate usage since the species does not measure fully to Smith's definition. Recognizing this discrepancy from a mere autopic glance, and though bound by the Rules he nevertheless uses the very proper species *harrisii* in illustrating venation and the bodily detail, quite representative of the genus.

Begging Sir George's pardon, this writer votes that *cerina* Grt. be superseded as genotype of *Papaipema* by *harrisii* Grt., if a more elastic rule be forthcoming some day.

The limitations of generic boundaries are subject to varying personal ideas but ideally their demarcation should suggest evolutionary trends in so far as that might be surmised.

Avoiding theory as much as possible but judging facts as they appear today, we can find much aid in turning to the larvæ in their earlier stages.

It is generally conceded that early stage larvæ reflect the primitive ancestral line at least phylogenetically. Leaning on this

<sup>2</sup> Cat. Lep. Phal. Brit. Mus., Vol. IX, p. 80.

deduction, a personal familiarity with forty *Papaipema* species seems to help in some measure while details of color pattern aid specifically. As larvæ *Papaipema* species are unique.

Their early larval pellicle is distinctly colored whereas most mining larvæ are at all stages more or less translucent.

The great majority show a contrasting middle ring of dark purplish or pinkish brown, in livid hue, at the first four abdominal segments while elsewhere longitudinal white or yellowish lines drawn on the darker body color produce striking individuals.

This intensity continues through the instars up to the penultimate, while maturity usually exhibits a faded translucence.

Three pattern types follow; the dark middle girdle may show an abrupt termination of all lines; or the dorsal line may cross it in unbroken continuity; or both the dorsal and subdorsal may be entirely unbroken. These features of pattern aid much specifically.

They are constant with two exceptions—the Pacific Coast species *angelica* and *insulidens*, where one, or rarely both lines may be continuous. One is tempted to assume that a progenitor was not wholly an internal feeder but subsisted within some encircling tissues with both extremities exposed and maintaining there the linear markings. The above category applies to thirty-eight known individuals. Two other known species are decidedly different and, again assuming, feature as admirable connecting links with their *Apamea-Gortyna-Hyroecia* relatives possessing a world-wide, north temperate zone dispersal. Because of this dispersal as against restricted North American *Papaipema* it seems rational to consider the latter as a subsequent offshoot. Their very close relationship bespeaks a comparatively recent evolution wherein possibly marked choices of food plants, some of the latter also restricted to America, may have played a part in influencing specific origin.

The larvæ of the two alleged connecting species, *frigida* and *beeriana* have their markings as transverse segmental rings, features prevailing with *Apamea erepta ryensis*, *Hydræcia immanis*, *H. micacea* and *H. stramentosa*, which is as far as familiarity goes.

The exotic *Xanthæcia flavago* larva is cross banded, while *Parapamea buffalænsis* and *Embolæcia sauzalita* have larvæ

which are longitudinally lined. This latter trio has the frons distinctly armed but these various genera may all figure as part of the "Gortynid series." This term has been used by the writer as a convenience, and in view of Grote's arguments,<sup>3</sup> *Gortyna*, genotype *micacea* Och., might properly find generic application somewhere therein.

As structural larval features, the heavy setigerous plates are noteworthy, with a peculiar development in many species that have an additional plate known as IVa, on joint ten. Since this plate bears no setal hair its transitory character may be adduced.

However it is one of the evidences aiding specific distinction.

The rugged genitalia become a prime structural feature with the adults. In the males such closeness to the conventional pattern prevails as to indicate the very near relationship of the species. Greatest modification exists with *furcata* and *eryngii*, while *frigida*, *unimoda* and *appassionata* make a decided break with the harpes greatly reduced. One might suggest a generic break here but full evidence points to connecting species.

With the female genitalia the genital plate at the ostium is of help specifically. It is a heavy, more or less shield-shaped process, differing in outline and scobinated characteristically. Dr. F. Heydemann in a praiseworthy treatment of the *nictitans* group of *Apamea*<sup>4</sup> notes the value of the genital plate and figures the character without other detail upon a single plate for specific comparison.

The close proximity of *Papaipema* species blend them together into a satisfactory whole. Indeed, in a number of instances they are so close that if no further evidence was at hand than a few flown specimens much doubt would arise as to their distinction.

Furthermore, variation is rife particularly in the feature wherein the ordinarily prominent white marked stigmata may be obsolescent or vice versa. This is productive of such an autopic difference that erroneously, two distinct species seem to be involved—vide Guenee's two alleged species, *nebris* and *nitela*.

That a varietal name be given to the lesser of such forms seems practical. This has been done in the more striking instances and

<sup>3</sup> Historical Sketch of *Gortyna*, Proc. Am. Phil. Soc., Vol. XXXIX, No. 162.

<sup>4</sup> Die Arten der *Hydroecia nictitans*, Sond. Ento. Zeit., XXXXIX u. XXXXV.

the future holds possibilities with slighter stigmatal variance likely to be grasped by some. Some dimorphism is observable, the ubiquitous *cataphracta* with its extensive food habits shows this in its more northern range, while *imperspicua* represented by a unique type may well be in that category. Until rearing proves the fact its specific standing may remain.

Two formerly considered species must merge as one, *verona* and *astuta* with the latter name preserved as varietal. Smith's unique type of *verona*, from Winnipeg, Manitoba, is a dwarfed pale form of the species, while *astuta* was applied to a larger more colorful variant with the terminal space solidly purplish, easily suggestive of distinctness. Both can occur in the same locality and though *verona* is less numerous in the writer's experience; it has priority.

That *astuta* be retained as a distinct color, or dimorphic form points to future expediency.

As to the placement of *Papaipema* holotypes, the writer has prepared a detailed treatment of the genus under title "The Epic of Papaipema," a unique copy which is willed to the American Museum of Natural History, New York, N. Y.

With it will go his collection of the group. Hence the holotypes and paratypes, with the relevant literature will be at one place for future students. The collection embraces something over fifteen hundred specimens, mainly reared. The various types number ninety-eight examples. The aggregation brings together not only the adults, but larval and pupal stages, to some extent the parasites; the foodplant habitations are also shown. The genitalic slides are not considered in this summary.

The "Epic" consists of three volumes. It assembles the principal published literature thus dealing with the historic rise and subsequent departures in the genus, treats monographically, matters of taxonomic import, features of parasitism and the gleanings of several decades of field study. Interlarded between the published papers, the author's notes and criticisms bring such up to current review. Particularly some of his earlier papers were rather puerile and in need of revision. Volumes I and II total 1127 pages, inclusive of the relevant articles. Volume III is a portmanteau affair.

Seventy plates occupying seven containers, are unbound for easy comparison; four containers hold autographed letters from important workers in connection with the subject, many of whom have now passed on. The plates illustrate by line drawings the infested food plants in some instances, larval features and the genitalia of both sexes in so far as possible, while the adults are shown in color. There is also a booklet of remarks and index of plates.

By what manner a commingling of the species of *Papaipema* can be best portrayed with their ontogenetic proximity apparently shown, it is convenient to resort to a popular vegetative process and erect a fanciful "tree."<sup>5</sup> Then, as nonconventional genes seem to have effected the protoplasmic stream, branches or shoots may materialize, either ascending or paralleling the main trunk according to the line of thought. Admirable as a basis of ideas, but to transplant this fruitage to the linear order of list column spoils the conception entirely. The writer can only suggest the following summary.

List order for the species of the genus

PAPAIPEMA Smith.

(Asterisk denotes larva unknown, synonyms in italics)

<i>frigida</i> Smith.	<i>inquæsita</i> G. & R.
form <i>thalietri</i> Lyman.	form <i>wyatti</i> Barnes & Benjamin.
<i>terminalis</i> Strand.	
<i>unimoda</i> Smith.*	<i>pterisii</i> Bird.
<i>beeriana</i> Bird.	<i>triorthia</i> Dyar.
form <i>lacinariæ</i> Bird.	<i>anargyria</i> Dyar.*
<i>appassionata</i> Harvey.	<i>ochroptena</i> Dyar.
<i>horni</i> Strand.	form <i>humuli</i> Bird.
<i>purpurifascia</i> Grote & Robinson.	<i>arctivorens</i> Hampson.
<i>luteipicta</i> Strand.	<i>merriccata</i> Bird.
<i>lysimachia</i> Bird.	<i>araliæ</i> Bird & Jones.
<i>nee purpurifascia</i> Auct.	<i>harrisii</i> Grote.
<i>stenoscelis</i> Dyar.	form <i>mulieris</i> Strand.
<i>speciosissima</i> G. & R.	sub. sp. <i>rubiginosa</i> Bird.
form <i>regalis</i> Wyatt & Beer.	<i>verona</i> Smith.
	form <i>astuta</i> Bird.

<sup>5</sup> EPIC OF PAPAIPEMA, 1940, pp. 553-554, Vol. II.

- rutila* Guenee.\*  
*depictata* Benjamin.\*  
*nepheleptena* Dyar.  
     *moeseri* Bird.  
*impecuniosa* Grote.  
*circumlucens* Smith.  
     *baptisiae* Bird.  
     form *ochroptenoides*  
     Benj.\*  
     sub. sp. *vaha* Benj.\*  
*marginidens* Guenee.  
     *birdi* Dyar.  
*nephrosyntheta* Dyar.\*  
*furcata* Smith.  
*rigida* Grote.  
*pertincta* Dyar.  
*limata* Bird.\*  
*insulidens* Bird.  
*angelica* Smith.  
*cataphracta* Grote.  
     form *sulphurata* Bird.  
     race *fluxa* Bird.  
*imperspicua* Bird.\*
- duovata* Bird.  
*ærata* Lyman.  
*placida* Bird.\*  
*cerina* Grote.  
*dribi* Benjamin.\*  
*polymniæ* Bird.  
*nebris* Guenee.  
     form *nitela* Guenee.  
*duplicata* Bird.  
     *obsolescens* Strand.  
*silphii* Bird.  
*necopina* Grote.  
*nelita* Strecker.  
     form *linda* Bird.  
     form *obicularis* Strand.  
*errans* Barnes & McDunnough.  
*engelhardti* Bird.  
*sciata* Bird.  
*limpida* Guenee.\*  
*cerussata* Grote.  
*eryngii* Bird.  
*maritima* Bird.  
*eupatorii* Lyman.